# US ANIMAL AGRICULTURE: MAKING THE CASE FOR PRODUCTIVITY

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This paper documents the tremendous productivity gains that have been made in United States (US) animal agriculture over the past century. Productivity gains will continue to be necessary as global demand for animal protein outpaces world productive capacity. Genetic technologies, with proper oversight and risk assessment, can provide great benefits for years to come.

*Key words*: animal agriculture; productivity gains; global demand; animal protein.

The history of agriculture is a long one. Agriculture started in the Golden Triangle of the Eastern Mediterranean Area where crops were first cultivated. Of the 4,800-mammalian species that exist on the planet today, about a dozen became easily domesticated. Cattle originated around ten to twelve thousand years ago by domestication of the now extinct species *Auroch* (Diamond, 1997). There were several separate domestications of cattle. One of which went to form the hump cattle found in the Indies, and the other the *Bos taurus*. Genes from both sub-species have contributed to the breeds that we know today. However, selective breeding of cattle to produce the milk and beef breeds that we recognize today only started about 200 years ago. Livestock breeding has progressed very rapidly since then, particularly during the latter part of the Twentieth Century.

Today, livestock production accounts for 30 to 40% of world agriculture production, and the demand for animal protein is increasing. Animal agriculture in the developed world has become increasingly science and knowledge based and where this model has been applied there has been enormous success.

## Examples Illustrating The Development Of Animal Agriculture In The United States (US)

### Broiler Production

The first known US broiler production facility was founded in the 1920s. The industry has greatly developed since then and, particularly, over the last four decades. It is also now concentrated in just a few states. Table 1 shows the gains in broiler production over time. Broiler weight has increased, market age has decreased, and feed conversion rates have dramatically improved. Almost 50% of feed is now converted to meat. Mortality rates have dropped considerably, in part due to the relatively effective control over Marek's disease, which is caused by a virulent virus. A combination

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of better veterinary care, nutrition, and, particularly, genetics has led to this remarkable improvement. Even though the basis for genetic improvements has not always been well understood, selection and breeding have been remarkably successful.

**Table 1: Improvements in Broiler Production Over Time.**

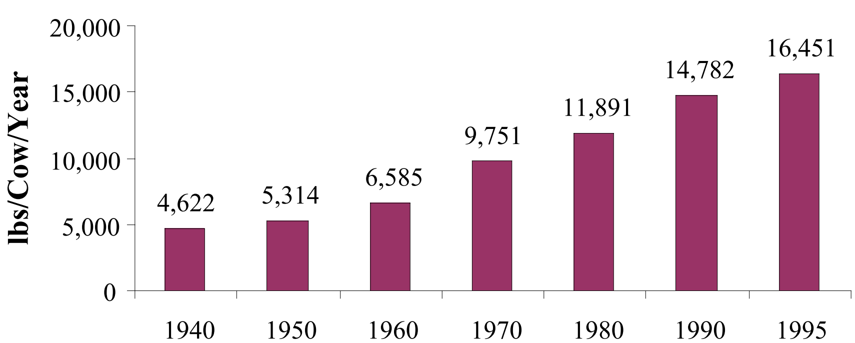
| Year | Average Live Weight | Market Age | Feed Conversion | Percentage (%) Mortality |
|---|---|---|---|---|
| **1920** | 2.0 | 16 | 5.0 | 18 |
| **1930** | 2.5 | 14 | 4.5 | 14 |
| **1940** | 3.0 | 12 | 4.0 | 10 |
| **1950** | 3.2 | 11 | 3.0 | 8 |
| **1960** | 3.4 | 10 | 2.5 | 7 |
| **1970** | 3.8 | 9 | 2.2 | 6 |
| **1980** | 4.0 | 8 | 2.1 | 5 |
| **1990** | 4.4 | 7 | 2.0 | 4 |
| **2000** | 5.1 | 7 | 2.0 | 5 |

Note. From "Broiler Production – Past and Future," by M.P. Lacy, 2000, Poultry Digest, 59, pp. 24-26. Adapted by this author.

Dairy Production

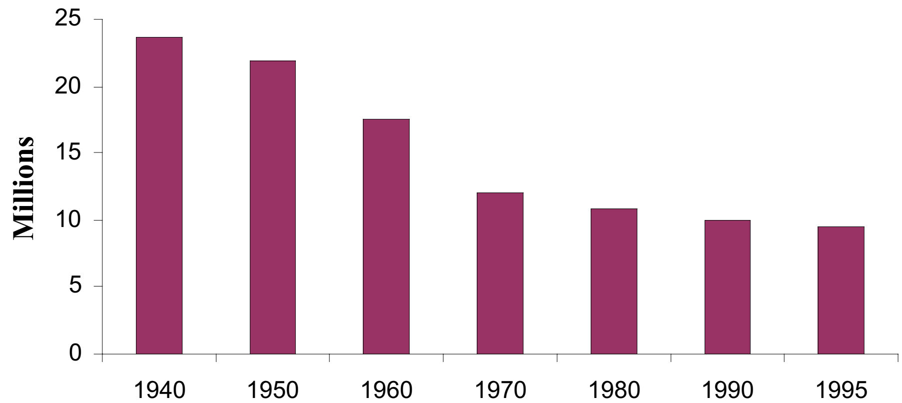
Remarkable production gains have also occurred in the dairy industry in the United States. There has been a three-fold increase in production of milk per cow over the last 55 years (figure 1). These data do not include the gains that have occurred from using bovine growth hormone (recombinant bovine somatotropin (rBST) or Posilac®). The genetics of the animal—the American Holstein—are primarily responsible for these productivity gains. The number of cows has decreased by almost two-thirds, and although large Holsteins individually consume more food and deposit more manure than before, on aggregate, less feed is consumed and less manure produced than 50 years ago (figure 2). Manure production is more concentrated, however, because less land is used for dairy production.

## Figure 1: US Milk Production Gains, 1940-1995.




Note. From "National Cooperative Dairy Herd Improvement," (Fact Sheet K-7), by J.L. Majeskie, 1996, pp. 1-17. Columbus, OH: National Dairy Herd Improvement Association, Inc.

**Figure 2: Reduction in US Cow Numbers, 1940-1995.**




Note. From "National Cooperative Dairy Herd Improvement," (Fact Sheet K-7), by J.L. Majeskie, 1996, pp. 1-17. Columbus, OH: National Dairy Herd Improvement Association, Inc.

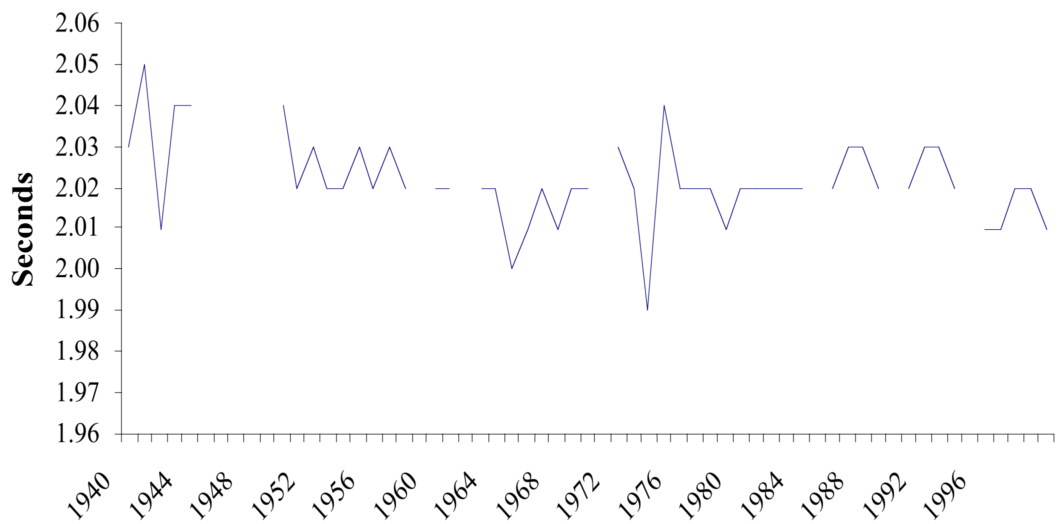
How were such gains achieved? The precursors of the modern milk breeds were gradually derived from farmed cattle that were selected according to their milk production. Improved nutrition and artificial insemination, which began on a large scale only in the 1950s, had an enormous impact on productivity. Other reproductive technologies, such as synchronization of animals for estrus breeding and bull progeny testing, have also made positive contributions. More recently, bovine somatotropin (BST) has given startling gains. As genome projects advance, new information will be used to select animals for desirable traits. With animal cloning techniques there is the possibility of maintaining desirable phenotypes (genotypes) indefinitely.

Other Animal Industries

The gains in pork production are equally as impressive. Selection of lean animals has been emphasized over the last 20 years, although characteristics that producers favor have sometimes been preferred at the expense of consumers. Uniform animals can be more efficiently processed to give a predictable end product.

Other animal industries (e.g., beef cattle) have not been the beneficiaries of similar structured improvements in genetics and management and, hence, have not experienced similar gains in productivity. An interesting case can be drawn from the US Thoroughbred Industry. The Kentucky Derby is the premiere horse race in the United States. Figure 3 graphs race times by year for the races in which the going was recorded as good or fast. There has been no statistically significant trend towards faster race times over the last 55 years. This result is interesting because it implies one of two explanations. Either there is a very narrow gene base upon which to draw or the thoroughbred industry has relied on arcane methods to improve the quality of the stock. Whatever the reason, it seems unlikely that Secretariat's winning time in 1976 will be beaten any time soon.

**Figure 3: Kentucky Derby Winning Racing Times.**




Note. From "Kentucky Derby history: 125 Years, race statistics," by Churchill Downs Inc., 2001. Available on the World Wide Web: http://www.churchilldowns.com/kderby/history/racestats/index.html.

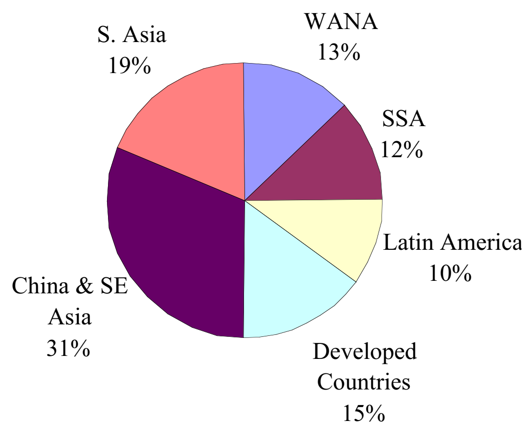
## Challenges And Opportunities Facing US Animal Agriculture

Animal agriculture is an often forgotten part of world agriculture, despite its scope and significance. Productivity gains will continue to be necessary as global demand for animal protein outpaces productive capacity. Figures 4 and 5 illustrate that the demand for animal products will keep pace with that for cereals and will be particularly high in East Asia and China. Clearly, the opportunities for exports are considerable. It is expected that the US animal agriculture sector will respond to such demand but will face strong competition from other countries, including Australia, New Zealand, Brazil, and Argentina.

## Where To From Here?

To deal with the increasing consumer demand for animal protein across the globe, improvements in productivity will not be sufficient. An honest approach to trade issues will also have to be adopted, although such a resolution appears to be less than straightforward. For instance, growth-promoting hormones have become the basis of a serious European Union (EU)-US trade dispute on the basis of alleged safety concerns. Growth promoting hormones for the most part are natural steroids, which provide an increase in growth and a reduction in fat during the finishing stage of cattle production. More than 60% of the beef cattle in the US receive anabolic hormones and more than 90% of the cattle fed in feedlots are implanted with this hormone. A small plastic implant is inserted through a gun into the middle section of the ear. The amount absorbed on a time-release basis provides only slightly higher serum concentrations than might circulate normally in adult cattle. Since these implants are located in the ear, they are easily removed at slaughter, and residual hormone does not enter the food chain. Just about all scientifically reputable toxicological tests for residues in carcasses and food performed on both sides of the Atlantic, have indicated no danger to human health. By contrast the amount of "natural" hormone in foods, such as milk or peas and other vegetables, dwarfs those found in meat from the treated cattle. One would also have to eat hundreds of pounds of beef to consume the equivalent amount of hormone present in a single birth control pill. Yet these naturally occurring steroids have been banned in Europe, closing an export market of around $100 million a year. To the US this appears as a contrived, protectionist trade barrier, putting undue pressure on a sector that is already struggling in a competitive world market.

**Figure 4: Increase In Global Demand for Cereals, 1993-2020.**




Note. S. Asia is an abbreviation for South Asia; WANA for Western Asia and North Africa; SSA for sub-Saharan Africa; and LA for Latin America. From "Securing and Sustaining Adequate Food Production for the Third Millennium" by A. Pinstrup-Andersen and R. Pandy-Lorch, 1999, in World Food Security and Sustainability: The Impacts of Biotechnology and Industrial Consolidation (NABC Report 11), pp. 27-48. Ithaca, NY: National Agricultural Biotechnology Council.

## Some Concluding Comments On Critical Emerging Issues

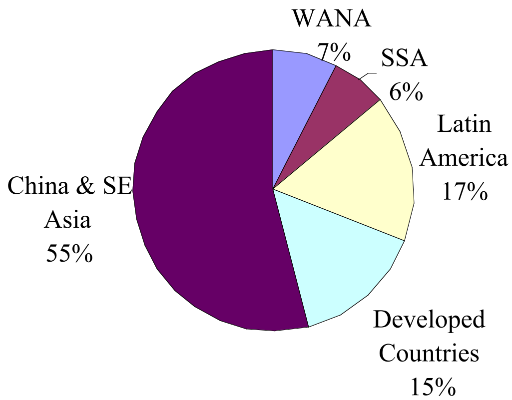
World Food Production

We are told repeatedly that the crisis in the World food supply is not one of production but of distribution and that the solution is political. Nevertheless, even if structural solutions improve food distribution, world population will soar from 6 billion to 10 billion, or thereabouts, by 2050. This increase in population will necessitate a vast increase in the amount of food produced. At the same time the area of useful agricultural land is shrinking and, in many cases, deteriorating in quality. As a result of this intensity of farming, natural resource management will have to be improved.

Investment in Agricultural Research

To maintain the historical gains in animal productivity, scientific knowledge through research must continue to advance. Relevant investment in agricultural research is needed in both Europe and in the United States to maintain food production and to achieve agricultural sustainability. Yet, it is unclear that such investments are possible within the existing political environment.

**Figure 5: Increase In Global Demand for Meat Products, 1993-2020.**

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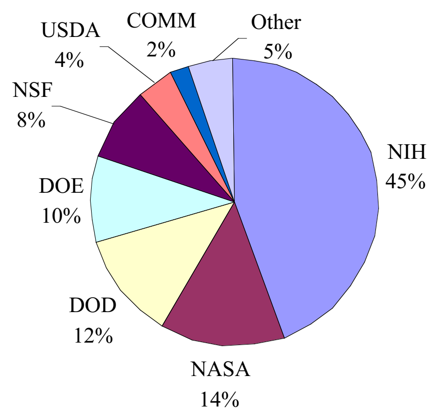
Before World War II, 40% of the US federal research dollars went into agriculture. The situation has changed markedly since then. Figure 6 shows non-defense research expenditures in the US for 1999. The USDA's slice of this pie is now only 4%, not a great deal of money for the challenges ahead. Of this approximately $1.8 billion, only a small fraction, less than $150 million, is directed towards long-term, peer-reviewed, competitive research. This amount palls in comparison with the $18 billion research expenditures administered by the National Institutes of Health (NIH) in 1999. The result is that most young researches are increasingly focusing their attention away from agriculture and toward the health-related research activities. Yet it is possible to make a strong case that agriculture is contributing greatly to the health of the US and global population, and that research is vital if agriculture is to continue to meet food needs.

Biotechnology

Emerging technologies must also be nurtured and employed effectively. Genetically modified foods are currently at a stage where they could founder or bring great benefit. Their existence is threatened as the result of perceived but, in many cases, unfounded safety considerations and the ensuing negative public response. Jarrod Diamond, in his book, Guns, Germs and Steel describes how the Japanese developed a sophisticated firearms industry in the sixteenth century, only to abandon it for 300 years because it conflicted with Samurai tradition. The development of technologies can be slowed down and even lost in an incompatible social context. Genetic technologies have a bright future in agriculture as well as in medicine. With proper oversight and risk assessment they can provide great benefit in the difficult times ahead.

**Figure 6: Federal Research Support ($35 billion), 1999.**




Note: NIH is an abbreviation for National Institute of Health; NASA for National Aeronautics and Space Administration; DOE for Department of Energy; DOD for Department of Defense; USDA for United States Department of Agriculture; NSF for the National Science Foundation; and COMM for the Department of Commerce. From "Congressional Action on Research and Development in the FY 1999 Budget," by K. Koizumi, A.H. Teich, S.D. Nelson, and J. Padrón Carney, 1998, (AAAS Publication # 98-11S). Washington, DC: AAAS. Available on the World Wide Web: http://www.aaas.org/spp/dspp/rd/rdwwwpg.htm.

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